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A. Koc, A.S. Kubat
Istanbul Technical University, Urban and Regional Planning Department, Istanbul, Turkey
e-mail: devecioglua@itu.edu.tr, kubat@itu.edu.tr

MORPHOLOGICAL TECHNIQUES FOR ASSESSING URBAN FORM OF ISTANBUL'S HISTORICAL PENINSULA

Abstract: *In this paper, the morphological transformation of historical peninsula in Istanbul is investigated. Urban form of historical peninsula evolved under the predominant influence of religion and culture; therefore, it bears this symbolic imprint. For this study, particular attention is given to Islamic social complexes and their surrounding settlements. These areas have ground and underground remains from different time periods (Roman, Byzantine, Ottoman and Republican), which play an important role in the dominating silhouette. To the best of authors' knowledge, it is the first attempt to analyze these study areas in terms of examining urban morphology in more detail. Urban morphology is an approach to analyze physical form of the cities, which is always transformed and developed by its inhabitants. Morphological change of region is related with social and economic context, which has a direct impact on town plan and building fabric. The study area is analyzed by adapting three different methods of urban morphology; 1) Conzenian school of thought based on the field surveys and large-scale plans, 2) an approach to block size and form proposed by Moudon, subject to typology of house forms and lots, and 3) space syntax theory based on natural roads, axial lines and angular segment analyses recently introduced by space syntax community to interpret changes, differences and similarities on urban form. Furthermore, historical GIS is utilized as a tool in order to create a database. The three concepts are applied in historical peninsula. The area includes considerable variety of urban form and archeological layers. The main purpose of the study is to understand how to perform and combine these approaches so as to investigate reflection of different civilizations on urban form and reveal the interactions of spaces on morphological structure for dealing with change. As a result, identification of unique characteristics of urban form, building pattern and transformation of town-plan is evaluated with combination of the different methods of Urban Morphology.*

Keywords: *Urban morphology, town-plan, building pattern, Istanbul, Space Syntax, Conzenian Approach.*

Introduction

The city has been formed by physical, social and natural constituents, which determine the morphological variety of cities. Throughout the history, cities have continued to change regarding the evolution of their physical and social patterns. In company with the physical, often conserved remains of the past they take place in the urban pattern forming. The morphology of the city is focused on continuity of physical form and structure, which have been affected by culture, society and everyday activity of inhabitants. Thus, the urban morphology is an important issue to the controlling of urban form and the development of the new urban environment.

The city is the accumulation and synthesis of individual and small group activities (Conzen, 1960). It is formed by social and economic forces and directed by cultural influences (Moudon, 1997). Urban morphology is a scientific approach to understand the changes in urban form in the light of human behaviour patterns and historical development of the cities. According to Bernard Gauthiez, since 1980s there have been used several methods for the analysis of urban form by the virtue of historiographical approach (Gauthiez, 2004). Urban morphology is a multidisciplinary

research, which architects, planners, geographers, historians and/or archaeologists are included in. Urban morphologists investigate the evolution of city's transformation via determining and allocating its variety of components. Over the years, various studies have been carried out in terms of historical approach. Such studies have been set out to examine the historical development in different countries. Kubat analyzed the comparative morphology in the light of space syntax method to examine the typological variety of urban form and identify the distinctive characteristics of nine different Anatolian fortified towns (Kubat 1997). Besides, Kubat analyzed quantitative implication of Istanbul's historical peninsula through space syntax (Kubat, 1999).

The study offers comparative research of different morphological approaches to the urban form by examining the city as a social and physical phenomenon and cultural force. The significance of morphological studies is explained on the example of historical peninsula through its ceremonial, administrative and religious function in the ancient world and its continuing evolution in the modern era.

The urban form of historical peninsula has not been investigated in detail despite the fact that the physical characteristics have changed over the years. In the scope of this study, the area including old residential cores and religious complexes is analyzed by using different methods to urban morphology; Conzenian school, the study of Moudon and space syntax theory have been applied to interpret changes, differences and similarities of urban form. Furthermore, historical GIS is utilized as a tool in order to digitalize, rectify and create a database. The aim of the study is to investigate reflection of different civilizations on urban form and reveal the interactions of spaces on the morphological structure for the purpose of dealing with change.

Methodology

The study is generally based on the following methodology: Conzenian tradition, North American studies conducted by Moudon and space syntax used to examine the changes in urban morphology of historical peninsula.

According to Conzen, a town can be defined as a topographical arrangement of the urban built-up area and its man-made features (Conzen, 1960). The geographical analysis in urban morphology explains the spatial arrangement and the nature of townscape consist of town plan, building fabric (building material-building type) and urban land use. Conzen established a framework of principles and defined complexes of plan elements, which are (i) streets and their arrangement in a street system; (ii) plots and their aggregation in street blocks; (iii) buildings or more precisely their block-plans (Conzen, 1960). Afterwards, the morphological regions were determined according to townscape components.

The study of Moudon investigates physical transformation of cities in neighborhood and micro scale. Moudon emphasizes that the physical structure of the city can be read from bottom to top (Moudon, 1982). This technique makes it possible to observe the process of change in typology by classification of building types. The key outcome is the morphological properties of built environment and typological features of buildings.

Space syntax as a design tool developed in United Kingdom at the end of the 1970s is aimed to understand the spatial and social relationship, read the city objectively and explore the movement of people (Hillier, 1996). The spatial relationships within an urban area as a distinctive element of space syntax are translated into an axial map, which consists of the least set of axial lines (Oliveira, 2015). Space syntax is a new mathematical language for defining the spatial patterns of both historical and modern cities by allowing the morphological analysis for the evaluation of the historical development. The method presents a variety of the topographical measures and this study focuses on three of them, which are connectivity, global integration and local integration.

GIS tool is used to analyze the city; make an analytical description of the natural features, main network, city block, lot pattern, land use, building layout, internal organization of building and height of building. This description is anchored by the methods that assist in the details of the

study. Each of them shows one of the special attributes and provides with outstanding data when analyzing these attributes into different time periods.

Research area

The research area selected for this study is based on three main criteria. First, the availability of historical data is necessary to examine the area from the scale of neighborhood level to building level. Secondly, the rich accumulation of urban forms as a sequence of historical stratification is a virtue for morphological research. Thirdly, the area is chosen to demonstrate the conserved physical elements of urban pattern in spite of the morphological transformation throughout history.

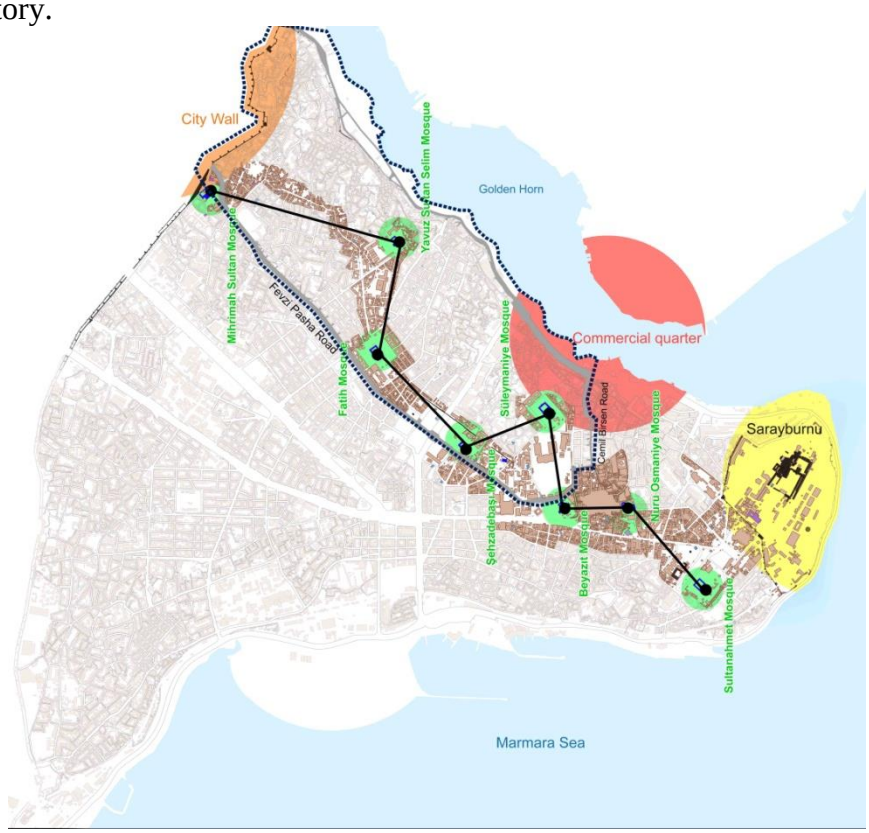

Figure 1. Location and importance of the study area

The study area is limited to the north by Golden Horn (Haliç), to the south by Fevzi Paşa road, to the west by the city walls and to the east by Cemil Birsel road. The northern part of the area (closed to the Cemil Birsel road) has been formed by the commercial quarter since Ottoman period, the southern side of the area facing the Fevzi Paşa road consists of the mixed-use area developed in the Republican period as shown in Figure 1. Additionally, the east-west direction of the area comprises the region of the religious complexes which are Süleymaniye Mosque, Fatih Mosque, Yavuz Sultan Selim Mosque and Mihrimah Sultan Mosque.

Measurement and analysis

Historical peninsula has more than one culture due to the impact of different civilizations, which are Roman, Byzantine and Ottoman Empires. Therefore, there are several planimetric and cartographical studies reflecting urban forms. The earliest plan prepared by French and German surveyors shows late Ottoman period (the map of German Blues map, after 1910s) and early Republican period (Pervititch map, between 1922-1945) of the area. German Blues map is a detailed survey of the street system. Pervititch map made for insurance after great fires provides more detailed information, such as streets, street names, a building ground plan, construction material, height, number of storeys and plot boundaries at a scale 1/500 and 1/1000.

Town plan analysis

Conzenian tradition presents town-plan analysis, which includes streets, buildings and plot patterns as a chronological sequence for the development of the town (Conzen, 1960). It provides a better understanding of the physical development of urban form. The starting point for identification of plan units in the study area is to define breaking points in historical events. The area has changed as a result of great fire and planning decisions, which have caused a grand evolution of urban pattern.

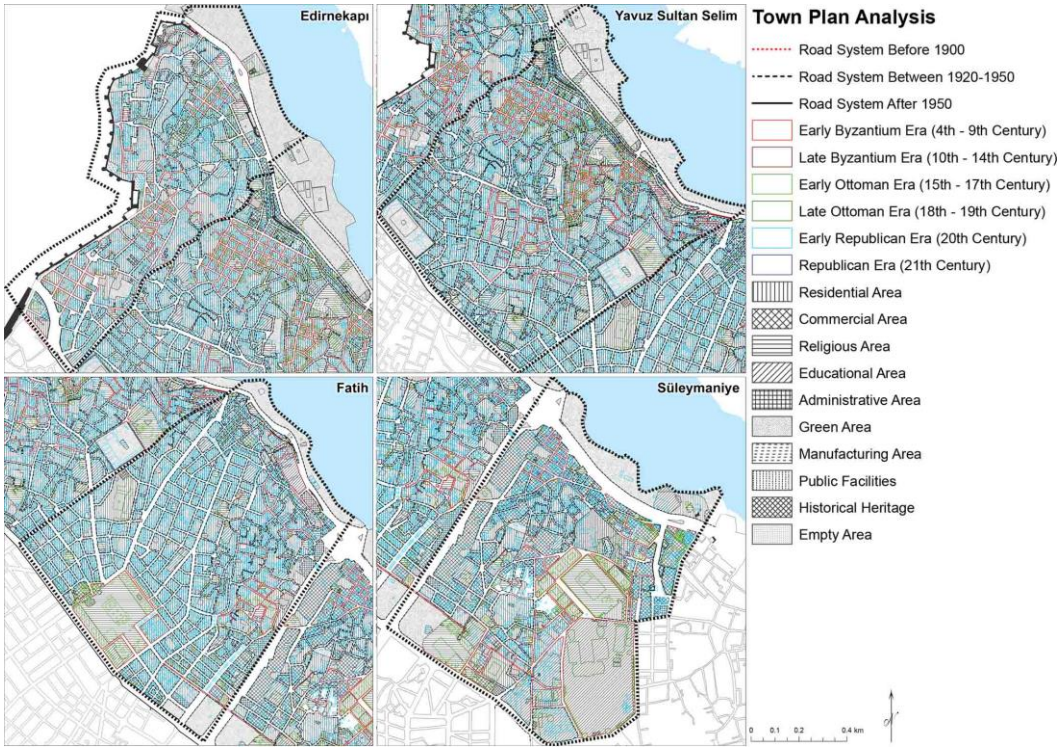

Figure 2. Town plan analysis of the study area

Figure 2 shows the town plan analysis including street system, building periods, lots and land use. The street pattern is formed by both grid and organic layout. Generally, the grid pattern has been designed as a result of great fire to increase accessibility. Drama Road as one of the oldest roads has been conserved as an commercial axis. According to the town plan analysis, the most conservative street lines are located closer to the city walls and the ancient Blachernae region. Besides, Balat and Süleymaniye neighbourhoods have undistorted urban pattern. On the other hand, the most significant change in street pattern has occurred with an opening of a new road from Edirnekapı (the city walls) to Beyazıt Square passing nearby Fatih Mosque. Additionally, the main road (Fevzi Paşa) has been enlarged to adapt to motorized development in 1950. These planning decisions have a small impact on surrounding urban pattern. Although historical buildings and some part of the city walls have been demolished after the enlargement of the Fevzi Paşa Road, urban blocks have been changed and regulated in accordance with the new street pattern. In other respects, the construction of Atatürk Boulevard has affected great urban area due to the clearance of residential area to extend new north-south axis in 1950. Afterwards, the large urban blocks have been designed to establish new urban environment. The most important examples of modern architecture such as IMÇ and Insurance buildings have been built in the large urban blocks, which are segregated from closed environment.

Morphological period

One of the most important concepts is morphological period introduced by Conzen. It is the social and economic development process, which shows the changes in urban form. The

differentiation in forms was associated with socioeconomic instability (Whitehand, 2014). Morphological period allows observing the evolution of notable cultural periods. Thereby, regions diversify as the result of changes during the cultural periods. Every period leaves the traces of its formation. Morphological periods represent the cultural history in consequence of various culture forms shaping the landscape according to their social needs and the physical forms.

Historical peninsula has three different morphological periods, which are Byzantine (330-1453), Ottoman (1453-1923) and Republican. Although Byzantine period has excessively affected the form of the city, there are insufficient cartographical records. On the other hand, the area has reached its prosperous urban pattern in Ottoman period, which has adequate cartographic records. The historical data illustrate the division of morphological period according to historical research. The Byzantine period began as the continuation of the ancient Nova Rome, East Roman Empire. Although the imperial palace, Hippodrome and forums were constructed before Byzantine Empire, the new city walls (the wall of Theodosius) and the complex of Blachernae were built in the 5th century. The Ottoman period started after the conquering of Istanbul in 1453. Afterwards, the declaration of Republic was a messenger for new period. It caused carrying intensive congestion in the old core. Therefore, the development of new built environment and housing types were inevitable. Therefore, the single-house units have turned into the multi-family houses. The republican period has characterized the city with re-planning the damaged area (after great fires in Ottoman period) and constructing the new boulevards (after 1950s) (Kuban, 2009). Today, Istanbul has spread over a huge area that has expanded beyond the wall of Theodosius. The population growth and the new planning decisions led to the city's rapid growth.

Morphological Frame

Town plan or ground plan is helpful for reading the city's development and it is the most resistant of urban form components to change (Conzen, 1960). Morphological frames are developed by use of plan and topographical features (Fig. 3).

The city walls constructed in the Byzantine period linearly formed the fixation line of the city and comprised the old core of the historical peninsula including the study area. This enables differentiation between the outside and the inside development of the historical peninsula. The main street (Fevzi Paşa Road) continues straight to the east-west direction dominated by the religious complex, institutional use and mixed-use area, although the main road (Draman road) still maintains its commercial areas. The city walls are not an effective element for the street pattern mainly influenced by topography, except for the grid pattern as designed after natural disasters. The city started to develop from the first hills and along the coastal line. It reached current position during the Ottoman period.

Morphological region

To specify morphological region reasonably, historical townscape is analyzed in a systematic way. First, genetic plan units are analyzed according to the town plan and time periods. This analysis includes building units, street units and land utilization in detail and they are elaborated as historical periods (Gu, 2010). Morphological region represents a homogenous area by demonstrating hierarchical order systems defined as first, second, third and fourth orders. They are ranked from the largest to smallest morphotopes, which is a terminology defined by Conzen. Historical peninsula as a whole is indicated as a first order comprising old settlement area surrounded by the city walls, which delimit the city's development. The boundaries of the second order are obtained from genetic plan units. The criteria for the identification of the third order are mainly based on land use. Besides, the fourth order designates the smallest morphotope, which is derived from the analytical map of building types and building blocks/lots. The most crucial consideration for specifying the fourth order is the smallest urban element, which shows distinctive character in urban form. In Figure 4, the colors show the land use of each

morphological region. There are four residential areas classified according to their density shown with a brown colour scale. The commercial areas, which are divided into three categories, are colored in red. Religious areas, green/open areas and institutional/educational areas with large building structures are demonstrated as distinguished from the third order because they have diversified urban elements.

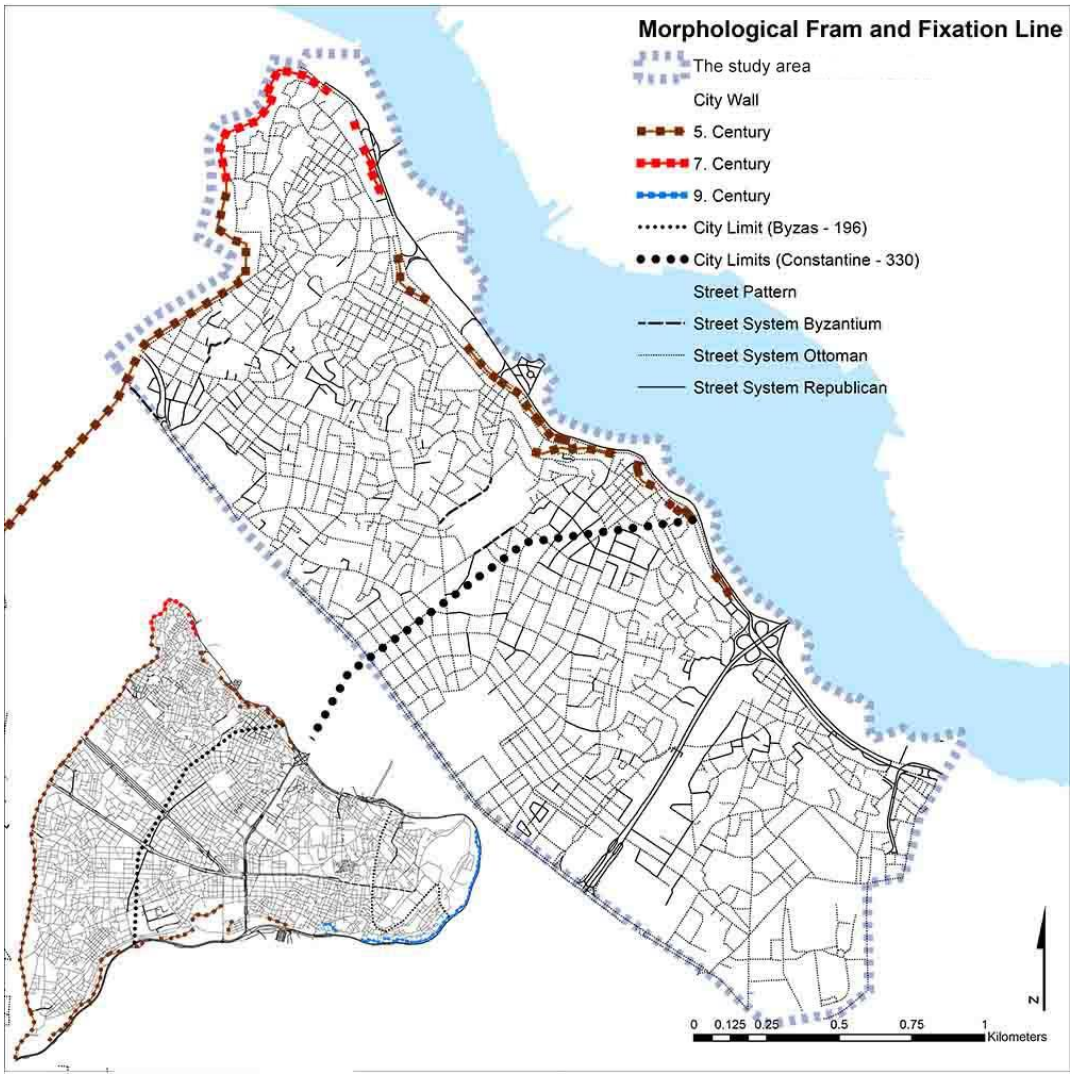

Figure 3. Morphological frames and fixation lines in the study area

Typological approach

North American studies conducted by Anne Vernez Moudon have remarkable morphological findings based on three schools of urban morphology. This study observes process of change in urban environment and building typology. According to Moudon, all elements affect each other from the smallest scale to the largest one (Moudon, 1985). The main purpose of the study is to show formation and transformation of urban and architectural form by exploring the evolution of street block/plot, and investigating a typological analysis of residential building types. It is necessary that this analysis should be made to understand each property and their relationships with the neighbour. Therefore, the analytical maps have been developed as shown in Figure 5. These analyses include land subdivision, the relationship between the land subdivision and outline of buildings at ground level, the figure-ground (footprint of buildings), the height of buildings and land use. By using the same map type and different time period, the change in urban pattern can be observed easily.

To specify the typologies of buildings we need to do three tasks: (i) identify the generation of buildings, (ii) identify types of buildings within each generation, (iii) determine transforming of each type within each generation over time. The aim of the analysis is to identify architectural characteristics of the city. This study includes two dimensions; the first one is the physical elements (houses and rooms), the second one is rules shaping these elements (Moudon, 1982). This approach is more applicable at the neighbourhood level. Thus, Süleymaniye region has been selected from the study area, as it shows great changes in urban pattern in terms of urban blocks, lots, land uses and building types, albeit traditional pattern is still protected.

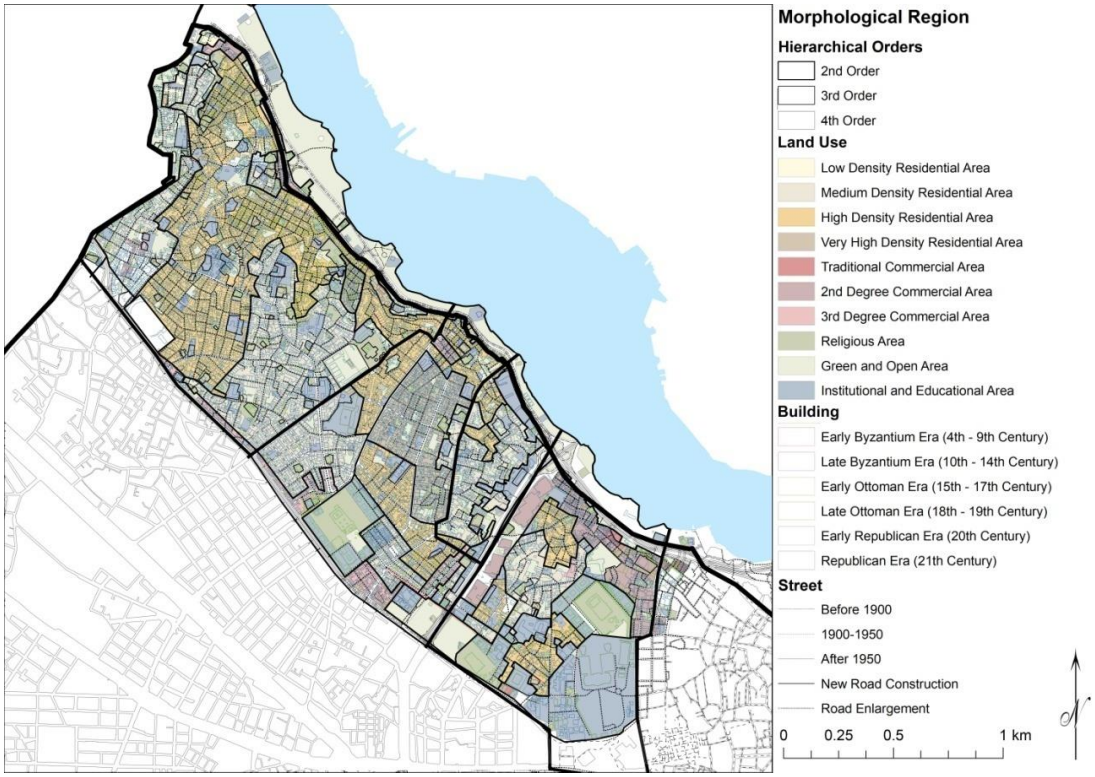

Figure 4. Morphological region in the study area

Figure 5. (i) Land subdivision, (ii) figure-ground, (iii) height of buildings, (iv) land use

The extensive development of Süleymaniye region is proved by the comparison of maps (1941 and 2016) as shown in Figure 5. The area has been filled by new structures, besides, the building heights have been raised up. Additional information about historical buildings can be obtained by analyzing old maps, the mansion of Ethem Paşa has been one of the examples of

Ottoman architecture but it is not conserved, while the buildings belonging to Süleymaniye religious complex are preserved in the authentic form. Additionally, the dominance of commercial and manufacture uses have caused replacement of some apartment units and/or mansions with commercial buildings. The residential buildings locating nearby the Süleymaniye religious complex have been replaced by apartment buildings exemplifying the increasing number of larger buildings. Other extreme change in urban pattern and land use has taken place along the coastal line. The hangars and small commercial buildings have been demolished to open the coastal line for the public use and new road construction.

The constitution of the building plan types is related with the organization of its elements. The planning elements of buildings include rooms, halls and staircases (Eldem, 1984). The number, shape and direction of the rooms are the most basic elements of the building plan type, because the rooms are designed in the same direction and each room has different significance. The most important rooms are located in the corners, which are the places receiving more light than the others. However, closets are the second valuable rooms because of the lack of light. The hall is shaped like a square in the built environment of gathering rooms. It is the centre of the movement. Therefore, the location and the shape of the hall is another important factor for the building plan types.

Traditional buildings have simple architectural plan which is sizable and is generally used for one-storey or two-storey buildings, for a single family houses, except for the mansions (Eldem, 1984). The traditional construction material of buildings is generally wood or masonry. The residential building types have been analyzed according to the internal organization of buildings and their position in the lots. The main differences between building plan types occurred in consequence of relations with the adjacent buildings or lot size/shape. The interaction between the lot and building types result in the various emplacement as shown in Figure 6.

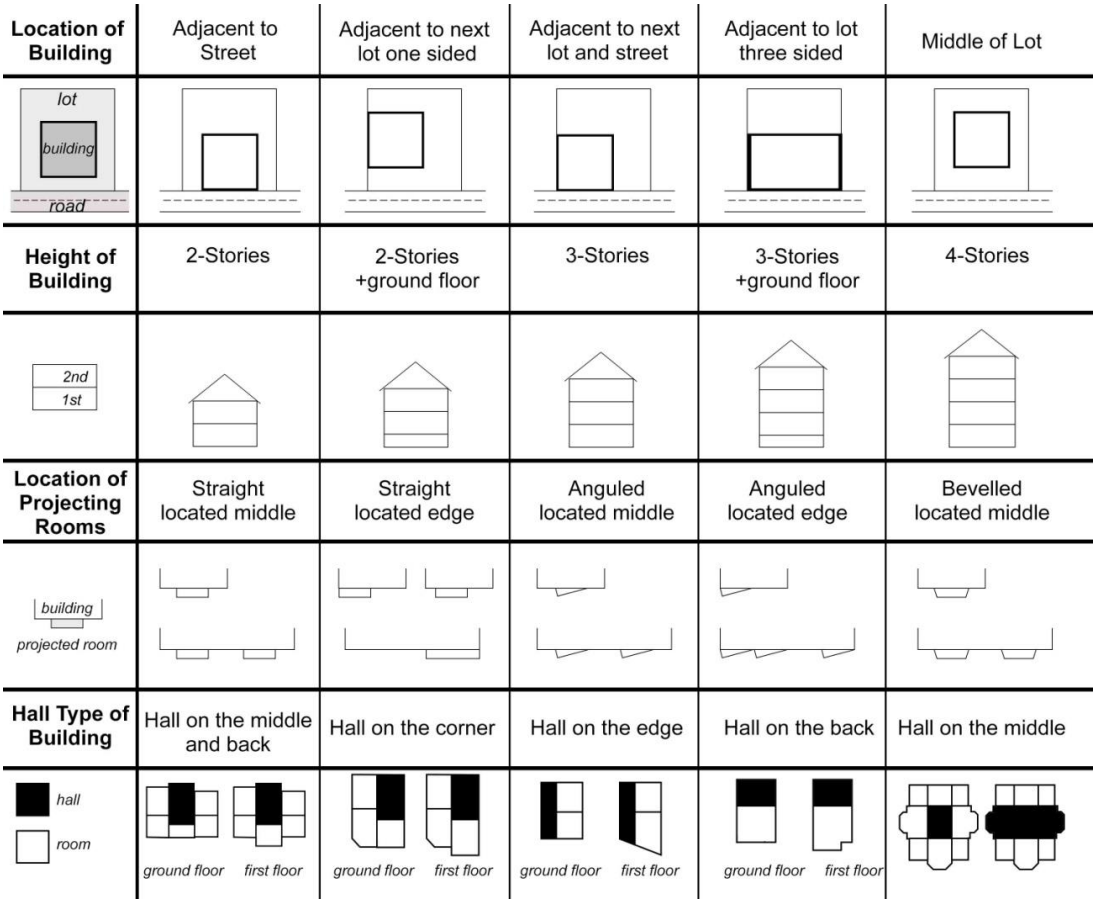

Figure 6. Location of building, height of building, location of projecting rooms, hall type of building for the Süleymaniye region

The Ottoman house design dominated before the 1950s and still characterizes some part of the area. The most outstanding building type has been the mansion consisting of a series of rooms and Turkish baths, ovens, etc. It has strong circulation space and widened hallway. The organization of the houses is not related to the lot size because they are detached houses. On the other hand, limited lot width shapes the room and circulation types of buildings. Rooms in the semi-detached and row houses are generally smaller than in the mansions. The location of rooms in a building is important because it describes the use of the room. If the room was close to the street, it was used as saloon while isolated rooms away from the street were used as bedrooms with relative privacy.

The transition from single to multi-family buildings is an evident circumstance after the increase in population. From the 1950s onwards, a large number of multi-family buildings started to be constructed in the area and other parts of the city. In the early 1950s, the buildings were small and were accompanied by yards or courts while the apartment buildings are covered parcels today. The changes in lot sizes can be visually seen between 1941 and 2016. According to Pervititch map, urban blocks were subdivided irregularly and many of them still can be recognized today. Lot sizes are bigger compared to the old ones affecting the building organization and form. While some of original parcels and buildings remained the same and were appropriated by the private sector, the land use in large lots changed from residential into institutional.

Space syntax

The method of space syntax, which is generally described as a set of theories and techniques for the representation and interpretation of the spatial configuration of buildings and settlements, is used to examine spatial representations of the built environment of the historical peninsula. This method is performed to explore nature of traditional street networks in Turkish cities as first attempt in Turkey (Kubat, 2001). It is aimed to understand the spatial and social relationship and read the city objectively. To adapt the space syntax method to the selected area, the historical map has been converted into numerical values. The axial lines are drawn on the digital map for different time periods. Additionally, segment map is created because of the lack of axial lines in defining the city in the wider and larger areas, which were introduced in order to interpret urban pattern more accurately (Turner, 2007). The generated axial and segment maps were analyzed by using the UCL Depthmap program. This program submits the maps turned into values and tables. In order to reveal differences and similarities for morphological changes, integration, choice and intelligibility parameters were determined. Finally, the analysis results were compared for the investigated area in different time periods.

Before the examination of the space syntax measures, some of the basic properties of the street network were presented in each study period. Between 1922-1945 and 2016, the total number of axial lines decreased considerably, from 2140 to 1557. While the mean length of axial lines in the system changed over time, the length of the longest axial line increased, from 2.1 kilometers in 1922-1945 to 6.0 kilometers in 2016. The reason of the decrease in the axial lines is avoiding cul-de-sac (dead end streets) which is poorly connected streets after the great fire. Likewise, the density of axial lines per square kilometer of urban area also decreased consistently with this claim. By examining the distribution of connectivity values for each year, according to the general situation of street system, there are a few highly connected street segments in the central core, but also the secondary connected street segments appeared in the grid of the street system. Moreover, the number of poorly-connected streets in 1922-1945 was larger than that of 2016 as shown in Figure 7. According to the measure of global integration, there is a relationship between the historical importance of streets and their degree of integration. On each map, the major road (Fevzi Paşa Road) has high integration values, whereas less significant streets have low integration values. By the end of the 19th century, some streets had been widened and new arterial had been constructed. Fevzi Paşa Road has been one of the most important commercial

arteries in the city since 1950. Also, Atatürk Boulevard has been constructed as the primary link between the harbor and Galata region. The integrated roads have shifted gradually away from the coastline from 1922-1945 to 2016. There is a decline in the mean, from 0.38 in 1922-1945 to 0.06 in 2016, it becomes slightly less integrated as shown in Figure 8.

Additionally, the local integration maps reveal the various street segments differently, some streets like gridiron street pattern are locally integrated, but not globally, as shown in Figure 9. The maps of local integration tend to resemble the connectivity maps. Both maps measure the local accessibility. In 1922-1945, the gridiron street pattern had the highest local integration values. These areas were the residential neighbourhoods redesigned after the fire disasters. The mean value of local integration in the street network decreased slightly over time from 0.17 in 1922-1945 to 0.14 in 2016.

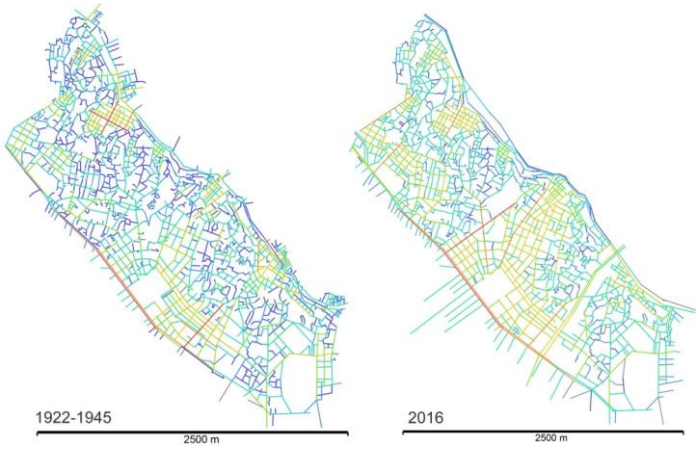

Figure 7. Connectivity map

Figure 8. Global integration map of the area

Figure 9. Local integration map of the area

Conclusion

Urban morphology is a multi-disciplinary research, which includes geography, architecture, archeology, history, philosophy, cartography, etc. In this study, three different approaches have been applied. There have been some difficulties and advantages when applying these methods. The identification of the unique urban form of historical peninsula has been introduced by using different approaches. It has been difficult for the selected area because of heterogeneity in the plot, building types, street forms, plan units and land utilization in terms of classification of the urban pattern. However, each method includes different scales from a building (the smallest element) to the regional scale. So, the methods support each other in terms of the analysis techniques they involve. It is believed that this study with its integrated methodology will shed light on the future studies assigning urban conservation and preparing urban design guidelines for the new development projects.

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